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UNITED STATES BUREAU OF MINES
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ACCIDENT EXPERIENCE AND COST OF ACCIDENTS IN WASHINGTON COAL MINES

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DEPARTMENT OF COMMERCE - BUREAU OF MINES

ACCIDENT EXPERIENCE AND COST OF ACCIDENTS AT WASHINGTON COAL MINES[1]

By S. H. Ash[2]

DIFFICULTY IN COMPILING ACCIDENT STATISTICS

In arriving at economic losses in coal mining due to accidents, a statistician is confronted with many difficulties on account of the lack of information relative to nonfatal accidents. For comparative purposes the experience of those countries, States, or companies that keep complete records can be drawn upon and an extimate can be arrived at whereby one State can be compared with another, or one mine compared with another in the same district. Such a comparison for the United States has been compiled by the United States Bureau of Mines.

It will be observed in Table 1 that the cost per ton for accidents in the State of Washington for the year 1927 is higher than for any other State, with the exception of Georgia and North Carolina, with a small combined tonnage of 130,089 tons. (The figures for coal production in Table 1 are taken from Bulletin 319, 1930, of the United States Bureau of Mines.)

The reasons why the cost of accidents in Washington might be higher than the average are on account of physical conditions such as steep pitches, faults, igneous intrusions, highly explosive coal-dust, extremely friable coals, presence of gravel and water, very gassy coal beds, rugged topographic conditions, inherently bad roof and floor, thick beds, and heavy cover. The nature of the coal beds requires the use of preparation machinery. The mines are often deep, and topographic conditions are such that long and fast haulage becomes necessary. All of these factors not only tend to cause high cost of production, which is manifested largely in a lower than average daily production, per man, but they also affect to some degree a tendency toward a higher than average cost for accidents.

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1 The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Information Circular 6529."

2 District engineer, U. S. Bureau of Mines Safety Station, Berkeley, Calif.

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Table 1.- Economic losses in coal mining due to accidents, 1927

State	Production	Men killed	Lost-time accidents[1]	Total days lost[2]	Wage loss, dollars[3]	Compensation loss, dollars[4]	Total loss, dollars	Cost
Alabama.....	19,765,866	93	14,322	1,503,810	7,519,050	663,090	8,182,140	$0.41
Arkansas	1,548,834	9	1,386	145,530	727,650	64,170	791,820	.51
Colorado	9,724,075	54	8,316	873,180	4,365,900	385,020	4,750,920	.49
Georgia and North Carolina	130,089	2	308	32,340	161,700	14,260	175,960	1.35
Illinois	46,848,224	104	16,016	1,681,680	8,408,400	741,520	9,149,920	.19
Indiana	17,935,758	39	6,006	630,630	3,153,150	278,070	3,431,220	.19
Iowa	2,949,622	15	2,310	242,550	1,212,750	106,950	1,319,700	.45
Kansas	3,443,762	9	1,386	145,530	727,650	64,170	791,820	.23
Kentucky	69,123,998	194	29,876	3,136,980	15,684,900	1,383,220	17,068,120	.25
Maryland	2,314,942	5	770	80,850	404,250	35,650	439,900	.16
Michigan	756,763	3	462	48,510	242,550	21,390	263,940	.35
Missouri	3,064,343	8	1,232	129,360	646,800	57,040	703,840	.23
Montana	2,966,638	13	2,002	210,210	1,051,050	92,690	1,143,740	.38
New Mexico ...	2,935,539	18	2,772	291,060	1,455,300	128,340	1,583,640	.54
North Dakota..	1,527,939	2	308	32,340	161,700	14,260	175,960	.11
Ohio	15,799,697	61	9,394	986,370	4,931,950	434,930	5,366,880	.34
Oklahoma	3,818,054	30	4,620	485,100	2,425,500	213,900	2,639,400	.69
Pennsylvania (bituminous).	133,141,639	336	54,824	5,756,520	28,782,600	2,538,280	31,320,880	.23
Tennessee	5,785,367	17	2,618	274,890	1,374,450	121,210	1,495,660	.26
Texas	1,326,385	2	308	32,340	161,700	14,260	175,960	.13
Utah	4,781,480	26	4,004	420,420	2,102,100	185,380	2,287,480	.48
Virginia	12,916,042	44	6,776	711,480	3,557,400	313,720	3,871,120	.30
Washington ...	2,635,062	22	3,388	355,740	1,778,700	156,860	1,935,560	.74
West Virginia.	145,122,447	593	91,322	9,588,810	47,944,050	4,228,090	52,172,140	.36
Wyoming	6,753,656	22	3,388	355,740	1,778,700	156,860	1,935,560	.29
Other States..	149,231	1	-	-	-	-	-	-
Total	517,763,352	1,742	268,268	28,168,140	140,840,700	12,420,460	153,261,160	0.30
Pennsylvania (anthracite).	80,095,564	489	75,306	7,907,130	39,535,650	3,486,580	43,022,230	.54
Grand total	597,858,916	2,230	343,574	36,075,270	180,376,350	15,907,030	196,283,380	0.33
Average (bituminous).	20,710,534	69.7	10,734	1,127,049	5,635,245	496,961	6,132,206	.30

1 Lost-time accidents based on British experience of 154 nonfatal accidents per fatal accident.

2 Time lost per accident, including fatal accidents, based on figures obtained from annual safety competition of the U. S. Bureau of Mines, is 105 working days per accident.

3 Wage loss is calculated at $5 per day.

4 Compensation loss based on National Safety Council estimate of $46 per accident, including fatalities.

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Economic conditions and highly competitive markets have given an intermittent career to many Washington mines, which has resulted more or less in a turnover in the personnel of local operating officials. Developmental programs can not be laid out far in advance, and often a situation results that requires an intensive developmental program, which is almost invariably accompanied by an increase in accidents. On the other hand, the mines do not have a large labor turnover at present, but rather an enviable one. The compensation laws are not drastic nor are the specific individual payments unusually high. The wage scale is satisfactory and the mines work more steadily than in many parts of the country. The State mining laws are more complete and progressive than the average. That Washington can and should have a lower accident cost is proved by the performance at some of the mines where supervision and discipline in the interest of safety as well as mining are being pressed.

SAFETY EDUCATION

In discussing the prevention of fatal accidents at the coal mines one Washington State mine inspector says:

> The State has gone about as far as possible in passing laws to safeguard the mine worker. Education of both the mine worker and mine official to "think safety" and avoid danger is the only way accidents can be reduced.

The recent educational work among the rank and file of industrial workers throughout the country has also been fostered among the coal mine workers of Washington to a degree that soon should show results. Educational work in safety in the past has in large part been directed toward the workman only, but education is necessary for all persons engaged in mining, if accident prevention work is to be a success, and should start with the management.

In making an address recently at a social gathering in the interest of safety at one of the mines in the State, one of the speakers emphasized in the following terms an outstanding fact that is uppermost in the minds of many companies, including the management of the large Washington mines:

> John Morgan, of the State Department of Labor and Industries, also made a splendid address. Among many other interesting remarks was this: "Gentlemen, I have attended many, many meetings in the past, but I want to say this meeting is unique. And what I mean by that is this: it is unique in that man, his welfare and well-being is uppermost. Unique in its underlying motive to make it possible for the breadwinner to return safely to his little wife and kiddies at the end of every workday. No safety campaign can function properly unless it starts in the swivel chair and carries right through to the face in an unbroken chain.[3]

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3 Pacific Coast Bulletin, vol. 10, No. 11, Seattle, Wash., Dec. 1, 1930, pp. 5 and 15.

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Education is essentially a product of several factors which result from instruction, experience, and pertinent information. This later phase of education when applied to accident-prevention work includes the subject of accident cost. It is a phase of mining of vital interest to the operator, workmen, and public. They all assume a part of the cost burden in mining, and a wider knowledge of the financial loss of accidents is responsible in large part for the active interest being taken recently that has for its purpose the lessening of accidents.

In setting up safety standards for the operation of hazardous industries, which include coal mining, the laws[4] of the State contain definitions pertinent to education.

FREQUENCY AND SEVERITY OF ACCIDENTS

The frequency with which all types of mine accidents occur is to a large extent a matter of conjecture, as accidents that do not result in time-loss on account of injury or in loss of life are not taken into account, although they may result in a large economic loss. For this reason some companies keep records of all accidents because any one accident may result in injuries, loss of life, and economic losses. When the same attention that is paid to fatal accidents is given to nonfatal accidents which result in injuries, or which do not result in injuries or loss of life, there is likely to be a large reduction in accident cost. The frequency with which lost-time, nonfatal accidents resulting in injuries, and fatal accidents, occur is a criterion of the frequency of all accidents.

It is often noticeable that as the frequency decreases, the severity per accident increases. The severity of accidents is important in throwing light on the economic loss and physical suffering resulting from accidents, as well as giving an idea as to the extent of the injuries and accident cost. Obviously, with no frequency there can be no severity.

In computing the frequency and severity rates, available State data have been used such as are embodied in the reports of the State mine inspector and of the department of labor and industries. The accident-frequency rate is based on the number of fatal and nonfatal, lost-time injuries per million man-hours. The accident-severity rate indicates the number of calendar days of disability from accidents per thousand man-hours worked.[5]

The accident-frequency rate per million hours and the accident-severity rate per thousand hours for 1927, 1928, and 1929 and for the period 1913-1929 are given in Table 2.

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4 Laws of Washington, Sec. 7675, Industrial Insurance Law, 1929.

5 Adams, W. W., Coal Mine Fatalities in the United States, 1928: Bull. 319, Bureau of Mines, 1930, 125 pp.

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Table 2.- Frequency and severity of accidents at Washington mines during 1913-1929[1]

Item	1927	1928	1929	1913-1929
Total man-hours	5,731,300[2]	5,465,500[2]	5,804,552	140,378,697
Fatalities:[3]				
Underground	21	9	9	342
Surface	1	0	2	29
Total	22	9	11	371
Time lost through fatalities, days	132,000	54,000	66,000	2,226,000
Compensable total permanent disability claims:				
Number	3	3	6	64
Time lost, days[4]	18,000	18,000	36,000	384,000
Compensable permanent part disability claims:				
Number	57	83	65	1,313
Time lost, days	--	--	18,226	188,153
Temporary disability claims:				
Number	581	585	563	11,143
Time lost, days	--	--	14,350	255,572
Total time lost through temporary disability and permanent part disability claims, days	22,641	36,465	32,576	443,725
Total time lost for all accidents, days	172,641	108,465	134,576	3,053,725
Total fatalities and compensable non-fatalities	663	680	645	12,891
Accident frequency (per million man-hours)[5]	115.6	124.4	111.1	91.8
Accident severity (time lost, days per thousand man-hours)[5]	30.122	19.845	23.184	21.753

1 Compiled from reports of Department of Labor and Industries, State of Washington.

2 Adams, W. W., Coal Mine Fatalities in the United States, 1928: Bull. 319, Bureau of Mines, 1930, p. 54.

3 State Mine Inspector Reports.

4 6,000 days time lost per accident.

5 Adams, W. W., Quarry Accidents in the United States, 1928: Bull. 325, Bureau of Mines, 1930, p. 90.

For the United States as follows:

	1927	1928
Accident frequency:		
In anthracite mines	99.6	88.1
In bituminous mines	97.3	85.0
Accident severity:		
In anthracite mines	9.927	10.918
In bituminous mines	15.739	12.471

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The foregoing figures show that the Washington rate is high when compared with either the anthracite or bituminous mines of the country. Although 1929 shows an improvement, the rate is considerably higher than in past years. It is apparent that there is considerable room for improvement, and although accident costs may appear high to some, the real difficulty lies in the frequency with which accidents occur and their severity when they do occur, rather than in excessive compensation rates. It is only by concentrated team work in accident-prevention work that the coal industry in Washington can hope to lower its accident cost.

COST EXPERIENCE OF COMPENSABLE CLAIMS

The Industrial Insurance Law of the State of Washington became effective in 1911, was operative during 1913, and in substance is as follows:

> An act relating to the compensation and medical, surgical and hospital care and treatment and the welfare and safety of workmen engaged in extra-hazardous employments, and to the compensation of the dependents of such workmen in case of death, and to the liability of the employers of workmen so engaged for such compensation and cost of such care and treatment, and to the collection of industrial insurance and medical aid premiums or assessments and fixing the priority thereof, and providing for injunction for nonpayment thereof, and relating to the liability of third parties for accidents occurring to such workmen, and providing for the extension of the benefits of this act to nonextra-hazardous employment.[6]

By the provision of this law the industrial insurance rate in 1929, for coal mining, class 16-1, was 3 per cent of the payroll and the medical aid rate was 8 cents per man-day. The application of the present act as amended dates from and includes the first day of July, 1927.

A compensation schedule in the industrial insurance laws of Washington provides as follows:

> Sec. 7679. Compensation Schedule.
>
> Each workman who shall be injured in the course of his employment, or his family or dependents in case of death of the workman, shall receive out of the accident fund compensation in accordance with the following schedule, and, except as in this act otherwise provided, such payment shall be in lieu of any and all rights of action whatsoever against any person whomsoever.

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6 Remington's Compiled Statutes, Laws of Washington, 1929, Secs. 7673 to 7711.

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In defining the status of injuries as a basis for claims, the law contains the following definitions:

> (b) Permanent total disability means loss of both legs, or arms, of one leg and one arm, total loss of eyesight, paralysis or other condition permanently incapacitating the workman from performing any work at any gainful occupation.
>
> (f) Permanent partial disability means the loss of either one foot, one leg, one hand, one arm, one eye, one or more fingers, one or more toes, any dislocation where ligaments were severed where repair is not complete, or any other injury known in surgery to be permanent partial disability.....
>
> (k) No workman injured after June 30th, 1923, shall receive or be entitled to receive compensation out of the accident fund for or during the day on which injury was received or the three days following the same.

Table 3, following, is compiled from data furnished by the Department of Labor and Industries of the State of Washington, and shows the industrial insurance cost experience of compensable claims, since 1913, following enactment of the compensation laws in 1911, to and including the year 1929:

Table 3.- Cost experience of compensable claims, 1913-1929

Description	1927	1928	1929	1913-1929
Temporary disability (T.D.) claims:				
Number	581	585	563	11,143
Time loss, days	-	-	14,350	255,572
Average time loss per claim, days	-	-	25.5	22.9
Cost	-	-	$24,246.30	$398,518.03
Average cost per T.D. claim	-	-	$43.07	$35.76
Permanent partial disability (P.P.D.) claims:				
Number	57	83	65	1,313
Time loss, days	-	-	18,226	188,153
Average time loss per claim, days	-	-	280.4	143.3
Total time awards (cost)	-	-	$29,961.95	$292,947.91
Average time award (cost)	-	-	$460.95	$223.11
Amount of permanent disability (P.D.) awards..	-	-	$37,308.00	$600,011.90
Average degree award ...	-	-	$573.95	$456.98
Average total cost per claim	-	-	$1,034.90	$680.09
Total cost of P.P.D. claims	-	-	$67,269.95	$892,959.81
Total cost, T.D. + P.P.D. claims	$67,300.80	$84,547.20	$91,516.25	$1,291,477.84
Total permanent disability (P.P.D.) claims, number...	3	3	6	64

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Table 3.- Cost experience of compensable claims, 1913-1929 - Continued

Description	1927	1928	1929	1913-1929
Total cost T.P.D. claims	$17,326.28	$26,536.91	$46,512.70	$384,936.0
Average cost per claim..	$5,775.43	$8,778.97	$7,752.12	$6,014.6
Total cost all nonfatal claims	$84,627.08	$110,884.11	$138,028.95	$1,676,413.8
Cost per nonfatal claim.	$132.02	$165.25	$217.71	$133.8
Fatal claims:				
Number	27	12	15	433
Number requiring pensions	23	7	11	288
Total cost of compensable fatal claims..	$164,571.84	$51,021.36	$63,732.05	$1,341,352.5
Average cost per claim	$7,155.29	$7,288.76	$5,793.82	$4,657.4
Total compensation cost.	$249,198.92	$161,905.49	$201,761.00	$3,017,766.4
Payroll	$5,755,642	$5,159,832	$5,232,214	$109,880,154
Compensation cost per $100 payroll	$4.32	$3.14	$3.86	$2.74
Coal, net tons[1]	2,631,337	2,519,410	2,591,666	50,722,320
Compensation cost, cents per ton	9.5	6.4	7.7	5.9

1 From State Mine Inspector's Reports.

It can be seen from the foregoing table that, although the number of compensable fatal claims was less in 1929 than for the average of the period 1913-1929, the compensation cost per ton has increased from 5.95 cents per ton to 7.7 cents per ton. It will also be observed that the compensation cost per $100 payroll is $1.12 higher than for the average of the period 1913-1929, or when based on the 1929 payroll it represents a loss of $58,600.

The reasons for the increase in accident cost are the increase in frequency and severity of the nonfatal accidents as well as the decrease in tonnage, especially from mines that formerly had a lower accident rate. Table 3 shows plainly the importance of nonfatal accidents and an outstanding reason why more significance should be placed upon them. More publicity should be given to nonfatal accidents through the mine inspector's reports, and more attention should be given to them in safety discussions.

Table 4 is a recapitulation and summary of compensable claims:

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Table 4.- Recapitulation and summary of compensable claims

Description	1927	1928	1929	1913-1929
Number of temporary disability (T.D.) and permanent partial disability (P.P.D.) claims	638	668	628	12,456
Time loss T.D. + P.P.D. claims, days	22,641	36,465	32,576	443,725
Gross wage loss (T.D. + P.P.D.)[1]	$157,355	[2]$288,074	$222,494	[1]$3,061,703
Wage loss per day[1]	$6.95	$7.90	$6.83	[1]$6.90
Number of total permanent disability claims (T.P.D.)	3	3	6	64
Number of compensable fatal claims	23	7	11	288
Number of T.P.D. and compensable fatal claims....	26	10	17	352
Total number of compensable claims	664	678	645	12,808
Total compensation cost of claims	$249,198.92	$161,905.49	$201,761,00	$3,017,766.43
Average cost per claim - (all claims)	$375.30	$238.79	$312.81	$235.62
Total number of nonfatal claims (T.D. + P.P.D. + T.P.D.)	641	671	634	12,520
Number of time-loss accidents (T.D. + P.P.D.) per compensable fatal claim..	27.73	95.42	57.09	43.25
Number of total permanent disability accidents per compensable fatal claim..	0.130	0.428	0.546	0.222
Total number man-days[3] ...	784,438	734,156	725,569	17,155,272
Number of nonfatal claims per thousand shifts worked	0.817	0.913	0.873	0.730

1 Gross wage loss. Net wage loss per day: 1927, $4.38; 1928, $4.87; 1929, $4.09.
2 Calculated.
3 State Mine Inspector Reports.

In the foregoing table it can be seen that accident costs are increasing in spite of the fact that fatalities have apparently decreased in 1928 and 1929. It will be observed that 1929 shows a material increase over the 17-year period and 1927, which was not a good year, both in the ratio of nonfatal to fatal compensable claims, and in the number of nonfatal claims per 1,000 shifts worked.

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Table 5 summarizes the compensable cases in coal mining for the period 1913-1929:

Table 5.- Review of compensable cases in coal mining for accidents, 1913-1929

Class	Cases		Per cent of total		Cost		Per cent of total	
	1929	1913-1929	1929	1913-1929	1929	1913-1929	1929	1913-1929
Temporary disability (T.D.)	563	11,143	87.3	87.0	$24,246	$ 398,518	12.1	13.2
Permanent partial disability (P.P.D.)	65	1,313	10.1	10.3	67,270	892,960	33.3	29.6
Total permanent disability (T.P.D.)	6	64	0.9	0.5	46,513	384,936	23.1	12.7
Fatal compensable cases	11	288	1.7	2.2	63,732	1,341,353	31.5	44.5
Total number non-fatal claims	634	12,520	98.3	97.8	138,029	1,676,414	68.5	55.5
Grand total	645	12,808	100.0	100.0	201,761	3,017,767	100.0	100.0

The foregoing table shows the compensable cases that have occurred in the coal-mining industry in Washington since the inception of the compensation law. It will be observed that there were 288 compensable claims for lives lost during the period 1913-1929. During this same period 371 persons were killed (Table 2); the difference between this figure and the compensable claims is explained by the fact that 83 of these persons were unmarried and their deaths did not originate pension cases. Their deaths, nevertheless, are a reality, and the number of compensable cases is a variable depending on whether the persons killed were married men or had dependents, or were single men.

It will be observed that there is a striking uniformity in the ratios maintained for the different classes of cases when comparing the number of cases for the year 1929 with the period 1913-1929. The temporary disability and permanent partial disability cases are practically constant, and there is only 0.1 per cent difference between the sum of the total permanent disability and fatal compensable cases in comparing 1929 with the 17-year period. This may be interpreted to indicate that either accident-prevention work, negative or positive, affects all causes alike, or there has been no concentration on any one particular phase of accident occurrence.

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The figures also show that, although temporary disabilities constitute 87 per cent of the cases, they account for only 13 per cent of the cost. In occurrence of accidents, Washington's experience is strikingly the same as in other States, notably Arizona, which goes to prove there is nothing vastly different in the percentage of occurrence in one field, or even in metal mines and coal mines, when one is compared with another, although there may be a vast difference in frequency and severity, depending largely on the extent and effectiveness of the accident-prevention work. This relation also shows that too much stress should not be placed on the assumption that high compensation costs are a result of persons making false claims or imposing on the benefits of the law; even if such cases now and then creep in, they do not have an appreciable significance on the total cost. Compared with the total number of cases and cost, such cases are an exception, not a rule. This is shown when it is observed that the cases of permanent partial disability and total permanent disability, although constituting but approximately 11 per cent of the total number of cases, account for approximately 45 per cent of the cost.

On considering the permanent partial disability cases, where there is a loss of either one foot, one leg, one hand, one arm, one eye, one or more fingers, one or more toes, any dislocation where ligaments were severed and repair is not complete, it is observed that they constitute 10 per cent of the total number of cases and represent that class of human wreckage which becomes to a more or less degree a charge of the community. The cost of this type of accident during 1929 was higher than that of fatalities, and on an average constitutes one-third of the total cost. They are chiefly classed as accidents from falls, haulage, and falling or flying coal.

On considering the total permanent disability cases, although they constitute less than 1 per cent of the accidents, they account for 13 per cent of the cost, and in 1929 reached 23.1 per cent of it. Falls of roof are mainly responsible for this type of accident.

The fatal cases, although they account for 44.5 per cent of the cost, constitute only about 2 per cent of the total number of claims. The fact that during the period 1913-1929 there were but 238 cases of the 433 fatal claims (Table 3) that required pensions, emphasizes the necessity of selective employment and accident-prevention work in extra hazardous occupations.

COST OF MEDICAL AID

During the year 1923 there was enacted into law[7] an act providing medical aid for injured workmen. In substance this act is as follows:

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7 Remington's Compiled Statutes, Laws of Washington, 1929, Secs. 7712 to 7726.

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Sec. 7712. Medical Aid to be Furnished Injured Workmen.

It is the intent to require the industries of the State to furnish medical, surgical and hospital care to their injured workmen and to place the expense thereof upon each industry as near as may be in the proportion in which it produces injury and creates expense.

The rate which each industry shall pay into the medical aid fund shall be as provided in Section 7676 of Remington's Compiled Statutes, which rate may be increased or decreased, by the director of labor and industries through and by means of the division of industrial insurance, based upon the medical aid cost experience of such industry.

From any change made in such rates any employer or workman claiming to be aggrieved may upon application, have a hearing before the division of industrial insurance upon notice to the interested parties and in the manner provided in Section 7697 of Remington's Compiled Statutes, a review by the courts. The body of interested workmen may designate in writing in duplicate, one of them to be the recipient of service upon all of them, one copy to be posted for local convenience, and the other to be filed with the supervisor of industrial insurance. In default of any such designation, service upon any one workman other than the one instituting a complaint shall be service upon all.

Sec. 7713. Creation of Medical Aid Fund.

A fund is hereby created in the state treasury to be known as the medical aid fund. Into it shall be paid by each employer on or before the 15th day of September, 1923, and on or before the 15th day of January, May, and September of each year thereafter for each day's work or fraction thereof done for him in extra-hazardous employment in or during the preceding four calendar months the medical aid rate provided in Sections 7676 and 7712 of Remington's Compiled Statutes.

The employer shall deduct from the pay of each of his workmen engaged in extra-hazardous work one-half of the amount the employer is required by the foregoing provision of this section to pay into said fund for or on account of the employment of such workman.

By the provisions of the law the medical-aid service can be provided either through the State or a contract system approved by the State. The rate deducted for service, however, is established by law and the medical-aid rate in 1929 was 8 cents per day, 4 cents of which was paid by the employer and 4 cents by each employee for each day he worked.

Table 6 shows the medical-aid costs under the non-contract system only, which is handled by the State, together with the actual costs in cents per day under this system:

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Table 6.- Actual medical-aid costs - noncontract system, class 16-1, coal mining

Year	Payroll	Medical aid costs	Cost, cents per day
1923	$6,642,892	$38,272.00	6.41
1924	6,261,022	40,753.73	7.25
1925	6,126,229	28,799.98	8.90
1926	5,549,251	10,298.51	5.09
1927	5,755,642	12,008.10	5.03
1928	5,159,832	12,643.38	5.33
1929	5,232,214	11,674.31	4.85
	40,727,082	154,450.01	6.43

NOTE: The variation in the amount of medical-aid costs in different years is materially influenced by the ratio of contract and noncontract systems of medical-aid service. From 1926 the major per cent of this service was under contract system, hence the reduced amount of medical-aid costs from the department medical-aid fund.
No count is made of the number of medical-aid claims by class; hence this information can not be provided.

Prior to the enactment of the medical-aid law, costs had to be assumed in one way or another by the employer and employee, and the law was drafted on the basis of past experience; rates covering the experience since the enactment of the law can well apply to experience prior to the enactment of the medical aid law. Further, the rates under the contract and noncontract systems are practically the same - the difference lying more in the matter of service. On the basis of the records of the medical-aid costs from the Department of Labor and Industries of Washington, Table 7 has been computed to ascertain the medical-aid cost to the coal-mining industry:

Table 7.- Medical-aid costs for the period 1913-1929

Year	At mines on noncontract system		At mines on contract system		All mines			
	Man-days[1]	Medical-aid costs	Man-days[1]	Medical-aid costs	Total man-days[1]	Cost per day, cents	Total cost[1]	Ratio contract to noncontract[1]
1913-1922					11,606,126	[2]6.43	$ 746,274	-
1923-1929	2,402,021	$154,450	3,147,125	$202,360	5,549,146	6.43	356,810	1.315
1927	238,729	12,008	545,709	27,449	784,438	5.03	39,457	2.287
1928	237,211	12,643	496,945	26,488	734,156	5.33	39,131	2.095
1929	240,707	11,674	484,862	23,516	725,569	4.85	35,190	2.018
1913-1929	-	-	-	-	17,155,272	[3]6.43	1,103,084	-

1 Calculated.
2 Rate for 1923-1929 used.
3 From State Mine Inspectors' Reports.

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With the exception of the first year (1923) of the operation of the medical-aid law, no count is or was made of the number of medical-aid claims by class; hence the cost per claim is largely conjectural. However, the records show that during the year 1923 there were 1294 claims that cost $34,022, or $26.29 per claim. Medical aid is given to all injured persons regardless of time loss, and many claims do not indicate compensable cases.

Table 8 shows the approximate cost of medical aid which is required by the industrial insurance law, and indicates that medical costs are decreasing, unquestionably due in large part to first-aid education, especially in the matter of protection against infection:

Table 8.- Relation of medical-aid costs to payroll and output

Year	Total medical aid cost[1]	Payroll[2]		Coal tonnage	
		Total	Cost per $100 of payroll	Total[2]	Cost per ton, cents
1913-1922	$ 746,274	$69,153,072	$1.079	32,271,747	2.3
1923-1929	356,810	40,727,082	0.876	18,450,573	1.9
1927	39,457	5,755,642	0.685	2,631,337	1.5
1928	39,131	5,159,832	0.758	2,519,410	1.5
1929	35,190	5,232,214	0.672	2,591,666	1.4
1913-1929	1,103,084	109,880,154	1.003	50,722,320	2.2

1 Calculated.
2 From Department of Labor and Industries of Washington.

SUMMARY OF ACCIDENT COSTS

The total cost of mine accidents can not be exactly ascertained on account of costs incidental to the rehabitation of properties after certain types of accidents such as explosions, fires, floods, bumps, and others. Disasters are almost invariably followed by a lowering of morale and an increase in labor turnover that are conducive to increased operating costs. Also haulage accidents often result in considerable property damage, frequently without injury to any person.

Table 9 shows approximately the economic losses in coal mining in the State of Washington that have resulted from accidents. It will be observed that the economic losses amount to approximately 50 cents per ton, which is higher than the average for the country. It will also be observed that the daily wage scale is higher than that assumed in Table 1. There was a slight reduction in accident cost for 1929 over 1927, although it is higher for 1929 than the average for the period 1913-1929.

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Table 9.- Economic losses at Washington coal mines due to accidents.

Item	1927	1928	1929	1913-1929	United States 1927[4]
Coal production, tons	2,631,337	2,519,410	2,591,666	50,722,320	597,858,916
Men killed	22	9	11	371	-
Total permanent disability claims	3	3	6	64	-
Time lost for temporary disability and permanent part disability accidents, days[1]	22,641	36,465	32,576	443,725	343,574
Time lost for temporary part disability and fatal accidents, days[1]	150,000	72,000	102,000	2,610,000	-
Total time lost, days[2]	172,641	108,465	134,596	3,053,725	36,075,270
Wage loss due to lost-time accidents[3]	$157,355	$288,074	$222,494	$3,061,703	-
Total wage loss[3]	$1,199,855	$856,874	$919,154	$21,070,703	$180,376,350
Compensation cost	$ 249,199	$161,905	$201,761	$ 3,017,766	$ 15,907,030
Medical-aid cost	$ 39,457	$ 39,131	$ 35,190	$ 1,103,084	-
Total cost	$1,488,511	$1,057,910	$1,156,105	$25,191,553	$196,283,380
Cost per ton, cents	57	42	45	49.6	33

1 See Table 2.

2 Based on 6,000 days lost per fatality and each total permanent disability claim.

3 Gross wage loss on basis of $6.95 for 1927 and $6.83 for 1929, as furnished by Department of Labor and Industries of Washington on total disability and permanent part disability claims (average $6.90). Net daily wage loss was $4.38 in 1927, $4.87 in 1928, and $4.09 in 1929.

4 See Table 1.

In arriving at the economic losses due to accidents by causes, it must be remembered that the time loss and compensation costs from each cause are not in direct ratio to the percentage of the number of accidents from the same cause. Statistics for nonfatal accidents have been compiled from the State Mine Inspector's Reports and the resultant economic losses by causes are shown in Table 10:

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Economic losses due to accidents, by causes, 1913-1929, showing compensation and medical cost and wage loss

Cause	Fatal and total permanent disability accidents				Nonfatal injuries - temporary disability and permanent part disability				Total		
	Percentage of total number of accidents	Compensation cost	Wage loss cost[1]	Total cost	Percentage of total number of accidents[2]	Compensation and medical-aid cost[3]	Wage loss cost	Total cost	Total cost	Percentage of total cost	Cost per ton of production, cents
Falls of roof and coal....	34.7	$ 600,288	$6,251,500	$6,851,788	36.5	$ 906,402	$1,408,853	$2,315,255	$9,167,043	36.4	18.0
Haulage	13.2	223,000	2,380,380	2,603,380	18.3	509,700	582,000	1,091,700	3,700,080	14.7	7.3
Explosions and fires...	19.8	342,000	3,560,500	3,902,500	2.9	62,000	91,850	153,850	4,056,350	16.1	8.0
Explosives...	3.4	53,000	612,700	670,700	0.8	21,000	21,600	42,600	713,300	2.8	1.4
Electricity..	6.0	103,500	1,080,540	1,184,040	0.4	10,500	10,800	21,300	1,205,340	4.8	2.4
Other causes underground.	17.5	302,000	3,150,500	3,452,500	32.4	833,600	874,600	1,708,200	5,160,700	20.5	10.2
Machinery outside	2.0	34,500	360,180	394,630	1.9	11,400	16,000	27,400	422,080	1.7	0.8
Other causes outside	3.4	58,000	612,700	670,700	6.3	39,960	56,000	95,960	766,660	3.0	1.5
All underground	91.7	1,583,006	16,514,253	18,097,259	88.6	2,091,378	2,724,916	4,816,294	22,913,553	91.0	45.1
All surface..	8.3	143,282	1,494,747	1,638,029	11.4	303,184	336,787	639,971	2,278,000	9.0	4.5
Totals..	100.0	1,726,288	18,009,000	19,735,288	100.0	2,394,562	3,061,703	5,456,265	25,191,553	100.0	49.6

1 Time loss taken on basis of 6,000 days per accident.
2 Compiled from State Mine Inspectors' Reports.
3 Calculated from percentage of compensation paid by Department of Labor and Industries of Washington.

A careful study of the foregoing tables shows that the cost of accidents in coal mining in Washington is such that a considerable saving can undoubtedly be effected by intensive accident-prevention work.

In showing figures that indicate economic losses, statisticians are confronted with a problem which many persons do not comprehend - the fact that loss in wages is a vital cost item; they believe that the only real cost is the compensation cost. Directly the compensation cost is the one the operator must meet, and with equal certainty the loss in wages is a burden that the workmen must sustain. The operator is obliged in one manner or other to assume this cost indirectly if not directly by wage schedules. In any event, the summation of these two items is passed on to the consumer or to the public at large and is a true cost burden that should ultimately be assumed by the industry.

In Table 11 a summary is given of the various items of accident cost that have a direct bearing on economic losses in coal mining:

Table 11.- Summary of accident costs statistics, 1913-1929

Item	1927	1928	1929	1913-1929
Cost per temporary disability accident	-	-	$ 43.07	$ 35.76
Cost per permanent part disability accident	-	-	1,034.90	680.09
Average cost per temporary and permanent part disability accidents	$ 105.48	$ 126.60	145.72	103.68
Cost per total permanent disability accident	5,775.43	8,778.97	7,752.12	6,014.63
Average cost per nonfatal accident	132.02	165.25	217,71	133.89
Average cost per compensable fatal accident	7,155.29	7,288.76	5,793.82	4,657.47
Average cost per compensable accident for all accidents	375.30	238.79	312.81	235.62
Nonfatal accidents per 1,000 shifts worked	0.817	0.913	0.873	0.730
Cost per $100 payroll, all accidents:				
Compensation	$4.32	$3.14	$3.860	$2.74
Medical aid	0.685	0.758	0.672	1.003
Wage loss	20.85	16.60	17.560	19.15
Total	25.86	20.50	22.09	22.90
Cost per ton, all accidents, cents:				
Compensation	9.5	6.4	7.7	5.95
Medical aid	1.5	1.5	1.3	2.1
Wage loss	46.0	34.0	36.0	41.5
Total	57.0	42.0	45.0	49.6

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It will be observed from the foregoing table that increasing accident costs are due in large part to the increased cost of nonfatal claims. If the years 1928 and 1929 are eliminated, it will be observed from the accident statistics that there is actually a greater number of fatalities for the 5-year period following 1921. The encouraging feature is that 1928 and 1929 show a favorable reduction in fatalities; however, they do not show a favorable reduction in nonfatal accidents. The cost per nonfatal accident in 1929 was $217.71 compared with $133.89 for the period 1913-1929.

A study of the statistics shows the outstanding fact that tons per life lost and man-days per life lost can be favorably reduced and the accident cost still increase, due to the greater frequency and severity of nonfatal accidents. The principal reason for this is that there was a reduction in fatalities due to explosions and electrical contacts. These two causes alone have contributed heavily to accident costs prior to 1928. Accidents caused by explosions and electrical contact are preventable. Although accidents from these causes have constituted a large percentage of the fatalities, they have constituted a very small percentage of the nonfatal accidents, and for this reason the elimination of such accidents does not materially affect the nonfatal accident cost.

It is by the reduction of accidents, both fatal and nonfatal, from falls of roof that accident costs can be materially lessened. It is from this cause that the greatest number of fatal and total permanent disability accidents occur. Their prevention appears to be practically at a standstill; the solution lies in more nearly adequate supervision, more rigid discipline, the strict enforcement of safety rules, and last but not least, the adoption and maintenance of a well thought out system of timbering or other support.

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